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Sexual Selection and Predator Avoidance in the Acoustic Lepidoptera: Discriminating Females Take Fewer Risks

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COMMUNICATION AND THE RISK OF PREDATION

It is a fundamental expectation of sexual selection theory that mating activities incur risk. Normally, these risks are considered from the perspective of male advertisement signaling, and studies in various animal species have documented increased predation associated with broadcasting those signals that are most attractive to females. Theory has regarded an exaggerated level of female choice to be potentially costly as well; however, remarkably few studies have examined this prediction (1). Here, we investigate the relationship between choosiness and risk exposure in females of an acoustic moth (*Achroia grisella*; lesser wax moth; Lepidoptera: Pyralidae).

ACOUSTIC COMMUNICATION IN THE LEPIDOPTERA

The acoustic Lepidoptera are a small but phylogenetically diverse assemblage of species in which hearing (and sound production) function in both pair formation and predator (bat) avoidance (2, 3). In *A. grisella*, males broadcast rhythmic series of 100- μ s pulses of ultrasound (~100 kHz; Fig. 1) that are attractive to receptive females up to 2 m distant (4). Females are influenced by signal energy and power (5): They prefer pulses that are longer, higher in peak amplitude, and delivered at a faster rate than the population mean. In addition to these relative aspects of sexual selection, female choice in *A. grisella* also entails absolute criteria (6): Females will not respond to a male pulse rate below a particular threshold value even when no other signaling males are present. Pulse rate thresholds are repeatable (and heritable) characteristics of individual females (7), range from 25 to 55 pulses/s and are modified little by other call features such as peak amplitude.

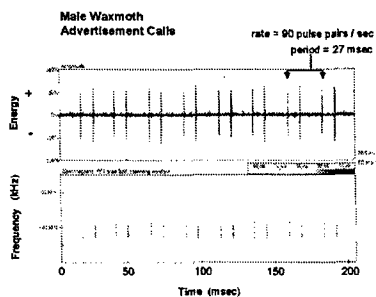


FIGURE 1. *Achroia grisella* male song.

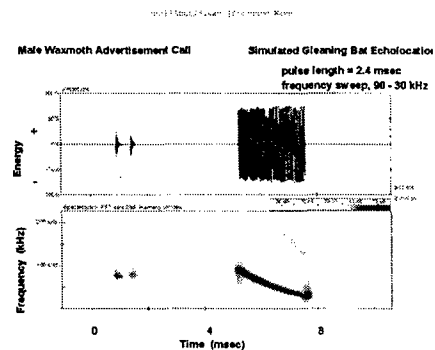


FIGURE 2. Simulated gleaning bat echolocation.

Our behavioral analyses showed that females exhibit striking inhibitory responses, the sudden cessation of movement (which can yield inadvertent sounds), when presented with lengthy (>1 ms; Fig. 2) ultrasonic pulses delivered at a rate slower than their threshold value (8). On the other hand, they orient rapidly and directly toward a loudspeaker broadcasting a pulse rate above threshold. Based on a survey of echolocation calls of foraging bats, we infer that the inhibitory responses observed in *A. grisella* females would confer predator avoidance, specifically of substrate-gleaning bat species (Fig. 2) in the field.

FEMALE CHOOSINESS PARALLELS RISK AVOIDANCE

Because threshold values vary among individuals (Fig. 3), are repeatable within them, and are categorical demarcations between signals treated as predatory or conspecific (Fig. 4), we obtained no evidence supporting the expectation that choosy females incur greater risks. Rather, we infer that those females that respond only to male signals in which the pulse rates exceed relatively high thresholds ($>50/s$) are also afforded the greatest protection from natural enemies, predatory bats (Fig. 3). This apparent lack of trade-off between sexual activity and risk may reflect the evolutionary cooption by which sexual communication originated in the acoustic lepidoptera. Phylogenetic analysis suggests that ultrasonic hearing ability was a widespread ancestral feature that was later "exploited" by male sexual advertisement in several isolated clades. Under such circumstances, a discrimination/risk trade-off may not be expected.

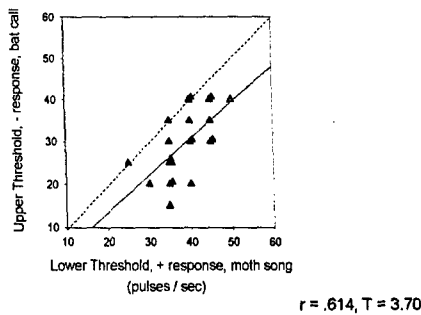


FIGURE 3. Risk-choosiness correlation.

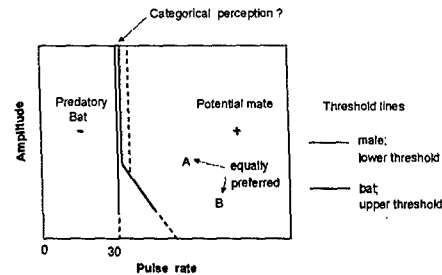


FIGURE 4. Signal categorization: bat echolocation vs. mating song.

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